for concluding that he had placed too great reliance upon the value of the mean motion determined in his memoir, and while obtaining a new value (about 650″) which would assign for the period of revolution in 1844 about 1994·0 days, he intimates the necessity of searching for the comet in future on the supposition that this period may be in error ± 30 days. At this distance of time or at the end of the sixth revolution since 1844, so great an amount of uncertainty of course renders the preparation of limited ephemerides useless, but it may be observed that the period finally deduced by Prof. Brünnow would bring the comet to perihelion again in the present summer, and it will certainly be worth while to keep a close watch upon those regions of the heavens which its path must traverse on this hypothesis; we might indeed expect, if the comet continues in the same condition as in 1844, that it would not escape detection, should the perihelion passage fall between the beginning of the present month and the middle or end of October. On July 14 its orbit is thus projected on the sky, the positions consequently indicating the line in which it should then be found according to the different suppositions as to the date of perihelion passage:—

| Time from Perihelion. | Right Ascension. | Declination. | Distance from Earth. | Intensity of Light. |
|---|---|---|---|---|
| + 40 days | 60°·3 | + 19°·3 | 1·89 | 0·17 |
| + 10 ,, | 43·0 | + 13·4 | 1·12 | 0·56 |
| − 20 ,, | 21·2 | + 3·0 | 0·64 | 1·68 |
| − 40 ,, | 350·1 | − 13·6 | 0·39 | 4·02 |
| − 50 ,, | 321·6 | − 24·8 | 0·34 | 4·78 |
| − 60 ,, | 289·3 | − 30·1 | 0·38 | 3·60 |

While it is of importance that an effort should be made to recover the comet, now to all intents *lost*, in the present year, no surprise need be occasioned if the endeavour should prove fruitless. It is quite possible that the mean motion in 1844 was of such amount as would bring the comet, with the influence of planetary perturbation into so close a proximity to Mars at the end of August, 1866, as to occasion very material changes in the elements of its orbit; and again there is the possibility that, as Dr. von Asten suspects has been the case with Encke's comet, it may have encountered one of the minor planets, and with the result of a sensible change in its motion.

And it is to be borne in mind to whatever cause or causes the circumstance may be due, that De Vico's comet has been shown by M. Le Verrier and Prof. Brünnow to be with great probability identical with the comet of 1678 observed by Lahire at Paris; yet in the long interval from 1678 to 1844 there is no record of a comet which can be identified with it, and in the early part of its appearance in the latter year it was visible to the unassisted eye. It does appear strange that in the days of Messier and Pons the comet should have escaped detection at one or other of its returns.

While writing on De Vico's comet we may mention that in heliocentric longitude 339°·6 this body approaches very near to the orbit of the periodical comet of D'Arrest, of which observations may be expected in the present year. The distance is within 0·0055 of the earth's mean distance from the sun, or about 507,000 miles, rather more than twice the moon's distance from the earth, but it does not appear likely that there has been any actual close approach of the two comets during the last fifty or sixty years.

THE LATE PROFESSOR HEIS.—We regret to record the sudden death of Prof. Edward Heis, the well-known German astronomer, which occurred on June 30 from an attack of apoplexy. Prof. Heis was born in 1806, completed his studies at Bonn in 1827, and received in 1852 a call to the ordinary professorship of mathematics and astronomy at the Royal Academy of Münster, Westphalia, which he filled until the time of his death. He was a most diligent and accurate observer in the particular branches of astronomical research to which he devoted himself. His "Atlas Cœlestis Novus" may be considered the standard work for magnitudes of the stars visible in central Europe, his acute vision enabling him to add a large number of stars of what he calls 6·7m. not included in Argelander's "Uranometria." While resident at Aix-la-Chapelle previous to his appointment to Münster he published the results of ten-years' observations upon shooting-stars which were carefully discussed. In 1875 appeared his observations on the zodiacal light, extending over the twenty-nine years, 1847-1875, and forming No. I. of *Publications of the Royal Observatory at Münster*; it is a most important addition to our collection of observations of this as yet little understood phenomenon. From 1858 to 1875 he edited the *Wochenschrift für Astronomie*, a periodical better known on the Continent than in this country. Prof. Heis was also the author of a collection of examples and problems in general arithmetic and algebra, which, we believe, has reached the forty-fifth edition in Germany. His observations of variable stars were conducted upon a system of extreme care, his researches in this direction being encouraged and guided by Argelander; he first established the variability of that irregular star $\epsilon$ Aurigæ, not without a long course of assiduous observation. He was an excellent draughtsman, and produced many fine pictures of nebulæ, though, unfortunately, supplied with very limited optical means.

## THE CAXTON EXHIBITION

It is not too much to say that Science has been advanced by the art of printing more than by any other of the world's inventions, for by it not only has the knowledge of scientific truth been spread throughout the world, but it has been perpetuated to all time, and the names of great heroes in science have been rendered immortal. Long after sculptured monuments, commemorative of the lives and work of great men have crumbled away, their written works remain, and the art of printing has contributed more than anything else to the bringing about of that result. The names of some of the greatest philosophers the world has ever seen would have had but a narrow and comparatively ephemeral celebrity, were it not for the record of their lives and writings which the productions of the printing press have preserved to them.

But great as have been the advantages which Science has derived from the printer's art, she has, in return, conferred as many and as important benefits upon the development of that art; and this is recorded in unmistakable language in the Caxton Collection, which, though (probably for want of space) very deficient as far as modern printing machines are concerned, constitutes a most interesting and instructive series of historical and typical forms, in which the rise and development of printing machinery may be traced from the early screw presses of wood used by Caxton and the early printers, through the Stanhope and lever presses of the last century, to the powerful steam machinery of the present day.

The principal aim of the designers of printing machinery has always been to obtain increased rapidity of working; and during the last fifty years this has been brought to an extraordinary degree of perfection. It was considered a wonderful feat when, in the year 1814, the celebrated König machine was started, throwing off 1,100 sheets of the *Times* newspaper per hour; but this number was doubled by König's second machine, which he brought out ten years after. In the year 1827, by means of Applegarth and Cowper's four-cylinder machine, the yield was raised to 5,000 per hour, and in 1848 the celebrated "Times" vertical machine was erected, which produced 12,000 single impressions per hour. The next advance was made by Richard Hoe, who, in 1857, introduced his cylinder machine into this country, where it was first

employed by the proprietors of *Lloyd's Weekly Newspaper*. Shortly afterwards the proprietors of the *Times* adopted it, and by means of a ten-cylinder machine, 16,000 single impressions of the *Times* were thrown off per hour. This was till lately the most rapid printing machine ever invented, but having to be supplied with separate sheets of paper from ten different feeding-boards, it required some twenty men and boys to work it. Since that time a still further advance in the art of printing has been made by the invention of the now celebrated Walter machine, by which the bulk of the *Times* is now produced. This machine works from a continuous roll of paper, printing it on both sides and—requiring the attendance of only a man and two boys—throws off 25,000 single impressions, or 12,500 complete newspapers, per hour.

In all these rapid machines the type *formes* are cast in cylindrically-curved stereotype plates, which are produced by first setting up the matter in type by the ordinary process and then pressing the *formes* so produced into *papier maché* moulds into which the stereotype metal is cast. By this means several plates from the same mould can be produced and therefore the same number of identical sheets may be printed at the same time.

With regard to the actual operation of printing the aid that Science has given has been almost exclusively in the direction of mechanical improvement and perfection. The art of stereotyping or the reproduction of plates and blocks for illustrations has, however, been developed by discoveries in many branches of Philosophy. Electricity has long been employed in the production of copies of wood engravings by the electrotype process, which copies are now almost universally used for rapid work where fine finish is not necessary, and the many processes in which photography is combined with engraving are every day becoming more generally employed for improving and facilitating the art of printing.

It will readily be understood that notwithstanding all the improvements in printing machinery by which such rapidity as we have referred to is insured, the art of rapid printing will be most materially hampered unless the operation of type-setting or composing can be carried on with corresponding rapidity. The importance of this is shown by the attention it has received and by the many systems that have been devised for mechanical and automatic type-setting. A special feature of the Caxton exhibition is the collection of machines for that purpose. Here again Science has lent her aid, and to any one interested in the applications of Science for the assistance of personal dexterity a careful study of the various machines exhibited will be found most interesting and instructive.

One of the most beautiful of these machines is the automatic type-setter of Dr. Mackie, which we illustrate in Fig. 1, and which is a most ingenious application of the well-known principle first invented by M. Jacquard, and applied by him to the operation of weaving, and which has since been employed for telegraphic and other purposes. In this machine a horizontal wheel, carrying a number of little platforms, revolves on a vertical axis beneath a set of upright boxes arranged in a circle round it. Each of these boxes is divided vertically into eight compartments containing the types; and the platforms, during the revolution of the horizontal wheel, pass in succession below, but without touching them. Each platform is furnished with eight adjustable projecting pins, that is to say, as many as there are compartments in the boxes. The use of these pins, or "pick-pockets" as they are called, is to remove the types contained in the corresponding compartments of the boxes at the moment of passing below them; and the types so removed, resting on the platforms, are carried round with them until pushed off at another point in their revolution, where they are collected and delivered in long lines in their proper order, and evenly spaced. The pins are automatically set up or left alone by the Jacquard mechanism to be referred to presently.

Calling the compartments containing the types and the corresponding pins on the platforms by the figures 1, 2, 3, 4, &c., it might at first be supposed that if, for instance, the pins 1 and 3 were set up, they would remove types from the first and third compartments of all the boxes as they passed beneath them, but this is provided against by the platforms being hinged at one end, so as to be capable of rising and falling through a small vertical arc, and by another portion of the Jacquard mechanism each platform is raised only when it is approaching that particular box which contains the compartments to which its projected pins correspond.

The regulation of the movements of both platforms and pins is effected by a set of levers, whose movements are determined by the positions of the perforations on a continuous ribbon of Jacquard paper, which positions correspond to the letters, spaces, &c., required to be set up. This ribbon is fed into the machine at a uniform speed by a

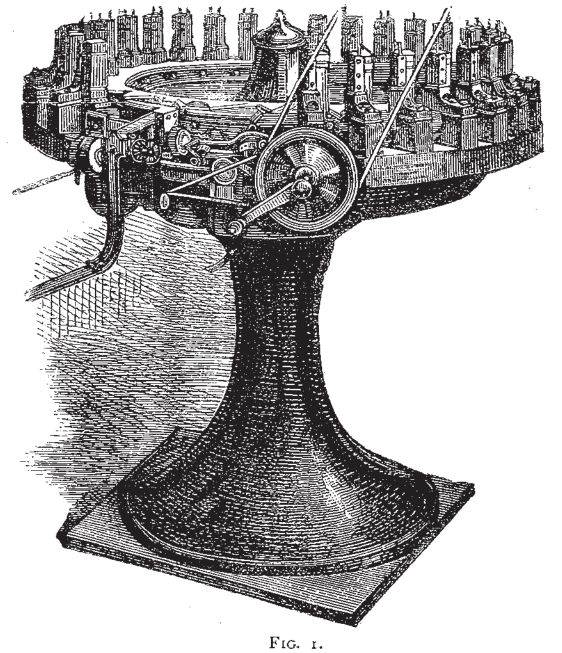

Fig. 1.

revolving spur-wheel armed with pins, which gear into a longitudinal row of holes punched along the centre of the strip of paper, and which is shown in Fig. 2, which represents a piece of the paper ribbon perforated for setting up the name of this journal, "Nature." The four lower rows, which are marked in the figure with Roman numerals, are those by which the rising and falling of the platforms are regulated, and the other eight rows, indicated by ordinary figures, correspond to the eight compartments of the boxes and control the protrusion of the pins or "*pick-pockets*." On reference to the figure it will be seen that the capital letter N is drawn from the fifth compartment of that box, under which a platform is raised by the dropping of the levers, which are controlled by the combination of the two lines of perforations marked I. and IV.; and again the small letter r is contained in the third compartment of a box whose platform is raised by the single lever corresponding to the row marked I.

The perforation of the paper is done at a separate instrument, which, at the Caxton Exhibition, is, in external appearance, exactly like an ordinary cottage pianoforte, the keys of which are marked with the letters, figures, spaces,

&c., and which, by simple mechanism, punch corresponding holes in the paper when pressed down by the fingers. This operation being quite independent of the machine last described, can be carried on at any slack time, or when the type-setter is in use, and the prepared paper can be put away until the machine is ready to work from it. This is a special advantage of the system which printers will readily appreciate; and it possesses another of great value, and that is that parts of words of two to eight letters, and several short words, can be set up simultaneously, as the compartments are so filled that letters likely to come together are in contiguous divisions and may be released by the mechanism at the same moment. As an instance of this the eight compartments of one of the boxes are filled with types in the following order:—w i t h a t s and spaces, so that the ten words wit, with, it, that, hat, hats, at, as, is, and has, may be drawn by one operation, and the preparation of the paper for such combinations is no less simple, for it is performed by depressing several keys at once, as in playing chords in music.

By this system of type-setting, using one, two, or three perforators respectively, as many as eight, twelve, and twenty-four thousand types may be set up per hour.

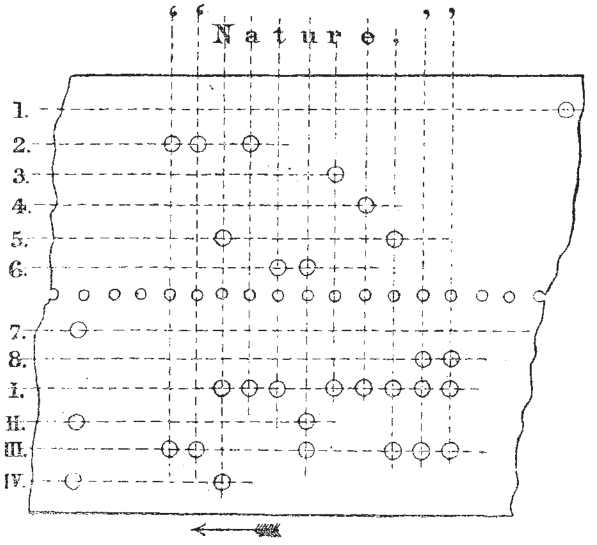


FIG. 2.

We have described Dr. Mackie's machine at some length, because it is a very beautiful application of the mathematical laws of permutations and combinations, and of mechanics to the saving of skilled labour, and is itself an interesting example of some of the services rendered by Science to the printer's art.

Another very ingenious application of Science to type-setting is the "Clowes" electrical compositor, invented by Mr. John Hooker. In this machine the types are contained in forty-eight nearly vertical troughs or reservoirs, and are pushed out through a lateral opening at the lower end by a *striker* under each trough actuated by an electro-magnet, so arranged that, when a current of electricity is sent through its coils, one type is released from its reservoir and drops out. Below the openings of the reservoirs are as many flat running tapes, and when a letter is released it drops on to the tape which is running below it, and is carried by it at the speed of seven inches per second to the edge of the table of the machine, where it is thrown on to another tape running at a quicker speed (about twenty-one and a half inches per second), and making an angle of about 150° with the set of parallel tapes before mentioned. This angle determines the relative distances of the reservoirs from the quick-running tape, and the speeds are so adjusted to these distances that the time occupied by a type in travelling from the reservoirs to collecting apparatus is exactly the same in all cases so that the types are delivered into the composing-*stick* exactly in their order of release from the reservoirs. This part of the apparatus may in telegraphic language be called the "receiving instrument."

The "transmitting instrument" consists of a series of rectangular plates of copper insulated from one another and arranged on a sloping board representing exactly the compartments in the ordinary compositor's "*Lower Case.*" Each of these plates is in metallic communication with one end of the coil of one of the discharging magnets, the other end being in connection with one pole of a voltaic battery consisting of two small Grove elements. The compositor sits in front of this set of plates, having the copy before him, and holding in his hand a copper stile or contact piece which is in connection with the other pole of the battery. Every time he touches with the stile one of the rectangular plates of copper a voltaic current is sent through the coils of its corresponding magnet and a letter corresponding to the plate touched is liberated on to the tapes and is instantly carried to the composing-stick. The collecting apparatus is extremely ingenious and is worked by a quick running cam by simple mechanism, which is a beautiful specimen of workmanship.

By this machine as many as 15,000 letters per hour may be set up; and it possesses the advantage over other systems that it can be worked by any ordinary compositor *at case*, and requires no special training for its manipulation.

Of other type-setting machines there are exhibited in the collection examples of Kastenbein's system, which is adopted in the *Times* office; the Hattersley compositor, in which the types are, by the depression of keys, shot down vertical grooves, by which they are guided to the composing frame, and by which it is said that types may be set at the rate of 8,000 per hour. Muller's machine, which is represented in the collection by a model, is a well-made apparatus, intended to set type at a speed of 5,000 letters per hour. Both this and the Hattersley machine set up the type in columns, ringing a bell at the end of each line.

Heinemann's apparatus is an exceedingly simple machine, depending upon quickness of hand and eye in aiming a pointer at the particular divisions of a comb-shaped series of guides, by which the types are withdrawn from the reservoirs corresponding to those divisions. It is a well-made machine, and its simplicity is a safeguard against its becoming deranged.

The operations of type-founding, of paper-making and folding, of lithography, and steel engraving, which are all more or less dependent upon scientific aid, are all represented at South Kensington, but we must reserve their consideration for a future notice, as well as a description of an interesting gas-engine, exhibited by Messrs. Crossley Brothers, which is admirably adapted for laboratory purposes.

From what has been said it will be seen that the Caxton Exhibition is an exceedingly interesting and instructive one, and will well repay several visits. C. W. C.

## NOTES

WE are glad to see that the first grants from the Research Fund of the Chemical Society have just been made. They are as follows: to Dr. C. R. A. Wright 50*l.* for the investigation of certain problems in chemical dynamics; to Mr. G. S. Johnson 25*l.* for a research on double salts with potassium tri-iodide; to Mr. E. Neison 25*l.* for a research on octyl compounds; to Mr. Carleton Williams 25*l.* for a research on hydrocarbons containing the group isopropyl twice; and to Mr. George Harrow 10*l.* for a research on derivatives of aceto-acetic ether.